Clarkson

Airshed Study

A Scientific Approach to Improving Air Quality

Addendum to Part II – The Ambient Air Monitoring Program: South Mississauga (Clarkson) and Oakville Sampling Results for Acrolein, Acrylonitrile and Dichloromethane in Ambient Air, Summer 2007

April 2009

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April 1, 2009

MEMORANDUM

TO: Dan Orr
Technical Support Manager (A)
Central Region

FROM: Susanne Edwards
Air Quality Analyst
Technical Support Section, Central Region

RE: South Mississauga (Clarkson) and Oakville Sampling Results for Acrolein, Acrylonitrile and Dichloromethane in Ambient Air, Summer 2007

During the implementation of the Clarkson Airshed Part II - Ambient Air Monitoring Program, detectable concentrations of acrolein in ambient air were occasionally measured at three monitoring stations in south Mississauga. Two of these stations (Site No. 44075 and 44080, also called Station QEW West and Station QEW East) were sited west and east, respectively, on the verge of the Queen Elizabeth Way and Highway 403 interchange. The third station (Site No. 46128, also called Station Industrial Centre) was located east of Winston Churchill Boulevard off of Royal Windsor Drive in Mississauga.

Similarly, detectable concentrations of acrylonitrile in ambient air were occasionally measured at five monitoring stations in south Mississauga and Oakville, with elevated concentrations observed at 2 of these monitoring stations. The five monitoring stations were Site No. 44075, 44080, 46117 (also called Station Industrial East), 44083 (also called Station Ford Drive, Oakville), and 44086 (also called Station Residential, Oakville). Elevated acrylonitrile in ambient air was observed at both Oakville locations, namely stations 44083 and 44086.

One June 2004 sample result for dichloromethane, an industrial solvent and paint thinner, exceeded the Ministry 24-hour Ambient Air Quality Criteria (AAQC) and the Ontario Regulation 419/05 Schedule 3 Standard, scheduled to take effect in 2010.

Acrolein is typically emitted into the atmosphere from the combustion and breakdown of petroleum products. For the acrolein results observed in the Clarkson Airshed Part II - Ambient Air Monitoring

Program, this attribution would be consistent with contributions primarily from vehicle emissions, with secondary contributions from the Clarkson industrial complex. Acrylonitrile is used in the manufacture of synthetic polymers or materials. For the acrylonitrile results observed in the Clarkson Airshed Part II - Ambient Air Monitoring Program, this attribution would be consistent with contributions primarily from the Clarkson industrial complex and the vehicle manufacturing facility in Oakville.

Based upon the preliminary results observed, surmising the source contribution areas, and knowing that both compounds are linked to known or suspected health effects, the Halton-Peel District Office requested that further ambient air monitoring for volatile organic compounds (VOC), particularly for acrolein, acrylonitrile and dichloromethane, be undertaken in the summer of 2007 to expand the VOC database for the south Mississauga-Oakville area.

This report focuses on the results for acrolein, acrylonitrile and dichloromethane sampling in ambient air the vicinity of industrial sources near Winston Churchill Boulevard on Royal Windsor Drive only. Detailed information of these sampling conditions are presented in Appendix 1. Competing monitoring priorities limited the number and duration of VOC sampling during 2007.

A total of three monitoring sites were installed, as shown in Figure 1, at the following locations:

1. 2255 Royal Windsor Drive (in the proximity of Station No. 46128),
2. 2509 Royal Windsor Drive (close to Universal Drum), and
3. 2645 Royal Windsor Drive (Electrovaya Inc.).

Figure 1: VOCs in Ambient Air Sampling Locations – Clarkson, Summer 2007

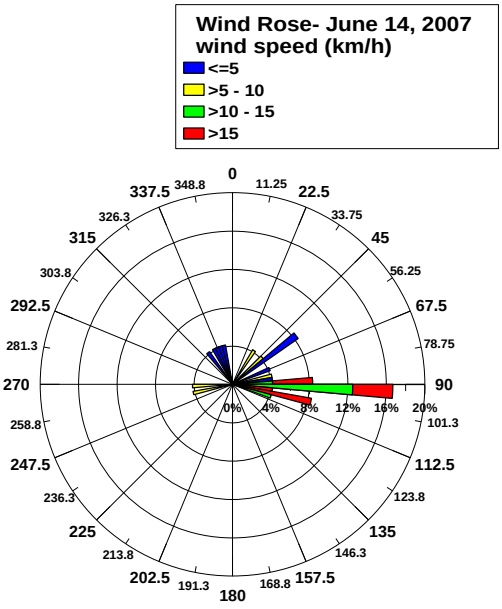
Air sampling for VOC determination was conducted using evacuated stainless steel 2-litre canisters with 24-hour calibrated orifices. Four samples were collected at each of the sampling locations, resulting in twelve samples in total. The samples were collected and submitted to Environment Canada for analysis according to the US EPA TO-14A/TO-15 methodologies.

The four daily (24 h) sampling events were collected on June 14-15, June 26-27, August 28-29, and September 20-21, 2007. Three of the four sampling events were conducted during smog advisories called for the Greater Toronto Area (GTA); June 14-15th, June 26th, and August 29.

Meteorological data from the closest AQI station in Oakville (Station 44017) was used to determine wind speed and direction during the sampling periods.

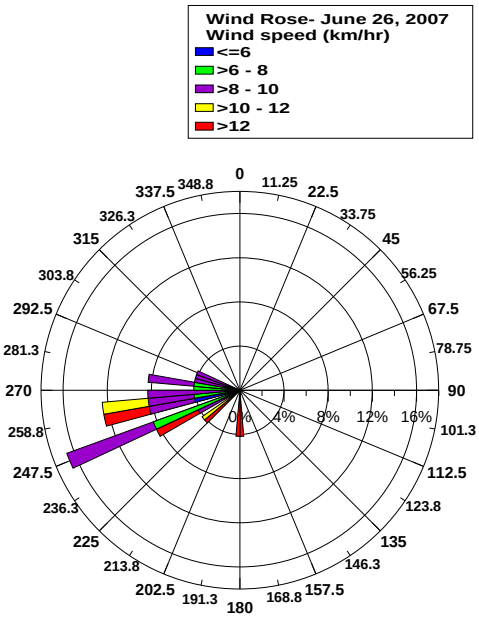
On June 14-15, 2007 the predominant winds were from the East quadrant where 62.5% of the time the wind direction was from 50 degrees to 110 degrees. The wind speeds ranged from 10 to 15 km per hour as illustrated in Figure 2.

Figure 2: Windrose plot for Station 44017 on June 14-15 Sampling Event



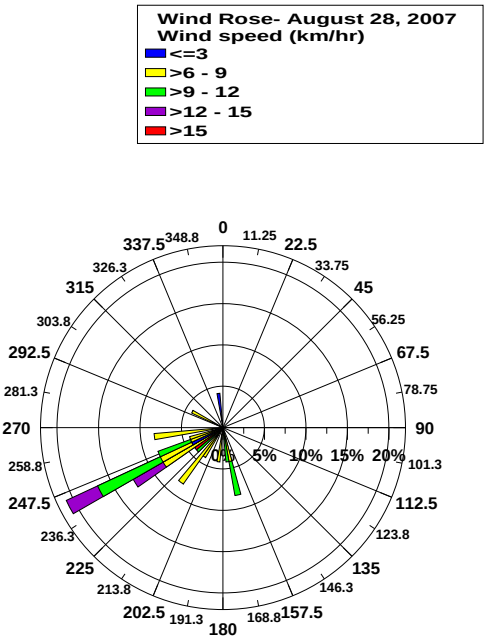
During the June 26-27, 2007 sampling event, the predominant winds were from the South West quadrant where 67% of the time the winds were blowing from 225 to 270 degrees. The wind speeds ranged from 6 to 12 km per hour as illustrated in Figure 3.

Figure 3 Windrose Plot for Station 44017 on June 26-27 Sampling Event



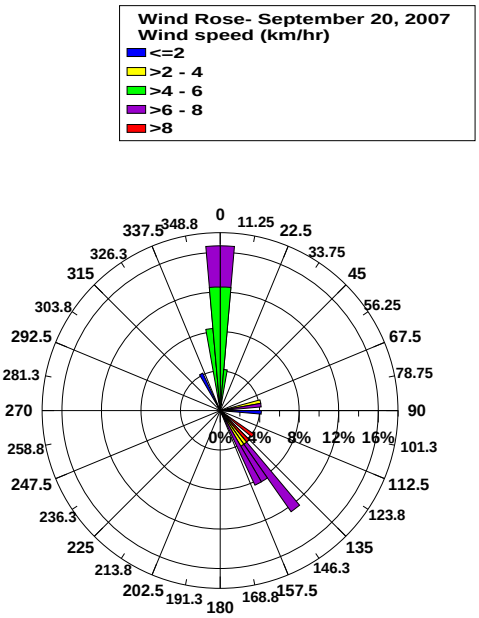
On August 28-29, 2007 the predominant winds were also from South-West quadrant where 58% of the time the winds were from 230 to 270 degrees. The wind speeds ranged from 3 to 15 km per hour as illustrated in Figure 4.

Figure 4 Windrose Plot for Station 44017 on August 28-29 Sampling Event



The fourth sampling event was conducted on September 20-21, 2007. On this day, the predominant winds were blowing from the North 49% of the time (330 degrees to 10 degrees) and later in the day (37.5% of the time) the winds changed to the South-East (125 – 155 degrees). The wind speeds ranged from 2 to 8 km per hour as illustrated in Figure 5.

Figure 5 Windrose Plot for Station 44017 on September 20-21 Sampling Event



The industries situated along Royal Windsor Drive between Winston Churchill and Southdown that potentially contribute to the Volatile Organic Compounds (VOCs) are:

1. UBA Chemicals (2605 Royal Windsor Drive),
2. Ashland Chemicals (2620 Royal Windsor Drive),
3. Universal Drums (2460 Royal Windsor Drive),
4. Stackpole (2400 Royal Windsor Drive),
5. PPG Canada Inc. (2301 Royal Windsor Drive),and
6. Blachford Ltd. (2323 Royal Windsor Drive).

The above industries are mainly involved in the manufacture of chemicals such as adhesives, lubricants, and synthetic polymers, or use a wide range of solvents in their process.

Other potential sources of VOCs, particularly acrolein emissions, are from vehicular traffic and other industries situated west of Winston Churchill, such as Ford Canada, and east of Southdown Road, such as Petro Canada Lubricants.

The sampling results for acrolein, acrylonitrile and dichloromethane are summarized in Table 1.

The daily (24h) concentrations for acrolein were all greater than the Reg 419/05 Schedule 3 standard of 0.08 µg/m^3, The maximum 24-hour average concentration obtained was 3.94 µg/m^3 during the August 28-29 sampling event at the 2645 Royal Windsor Drive station.

During Phase II of the Clarkson Airshed Study, the maximum 24-hour average result obtained was 0.51 µg/m^3 at the Industrial Centre station. In addition, the acrolein levels

Table 1 Daily (24 h) Acrolein, Acrylonitrile and Dichloromethane Concentrations (ug/m^3) in Ambient Air in the vicinity of Royal Windsor Drive, south Mississauga, Summer 2007.

Sampling Dates	Acrolein [1]	Acrylonitrile [2]	Dichloromethane [3]	Location	Station ID. 44017 WD (deg)	Station ID 44017 WS(km/h)
June 14-15, 2007	0.58	<MDL	1.07	2255Royal Windsor	51	4
	1.37	<MDL	8.59	2509Royal Windsor		
	1.70	<MDL	40.5	2645Royal Windsor		
June 26-27, 2007	1.78	<MDL	1.40	2255 Royal Windsor	246	7
	1.69	<MDL	0.75	2509 Royal Windsor		
	1.21	<MDL	0.71	2645 Royal Windsor		
August 28-29, 2007	1.85	<MDL	16.3	2255 Royal Windsor	237	7
	2.14	<MDL	1.81	2509 Royal Windsor		
	3.94	<MDL	2.25	2645 Royal Windsor		
September 20-21, 2007	1.51	<MDL	1.55	2255 Royal Windsor	7	5
	1.93	<MDL	126	2509 Royal Windsor		
	1.08	<MDL	9.57	2645 Royal Windsor		

Notes: The MDL (method detection limit) for acrylonitrile and acrolein is 0.031 ug/m^3 and 0.027 ug/m^3, respectively.

1. O. Reg 419/05 Schedule 3 24-hour standard is 0.08 ug/m^3
2. O. Reg 419/05 Schedule 3 24-hour standard is 0.6 ug/m^3
3. O. Reg 419/05 Schedule 3 24-hour standard is 220 ug/m^3

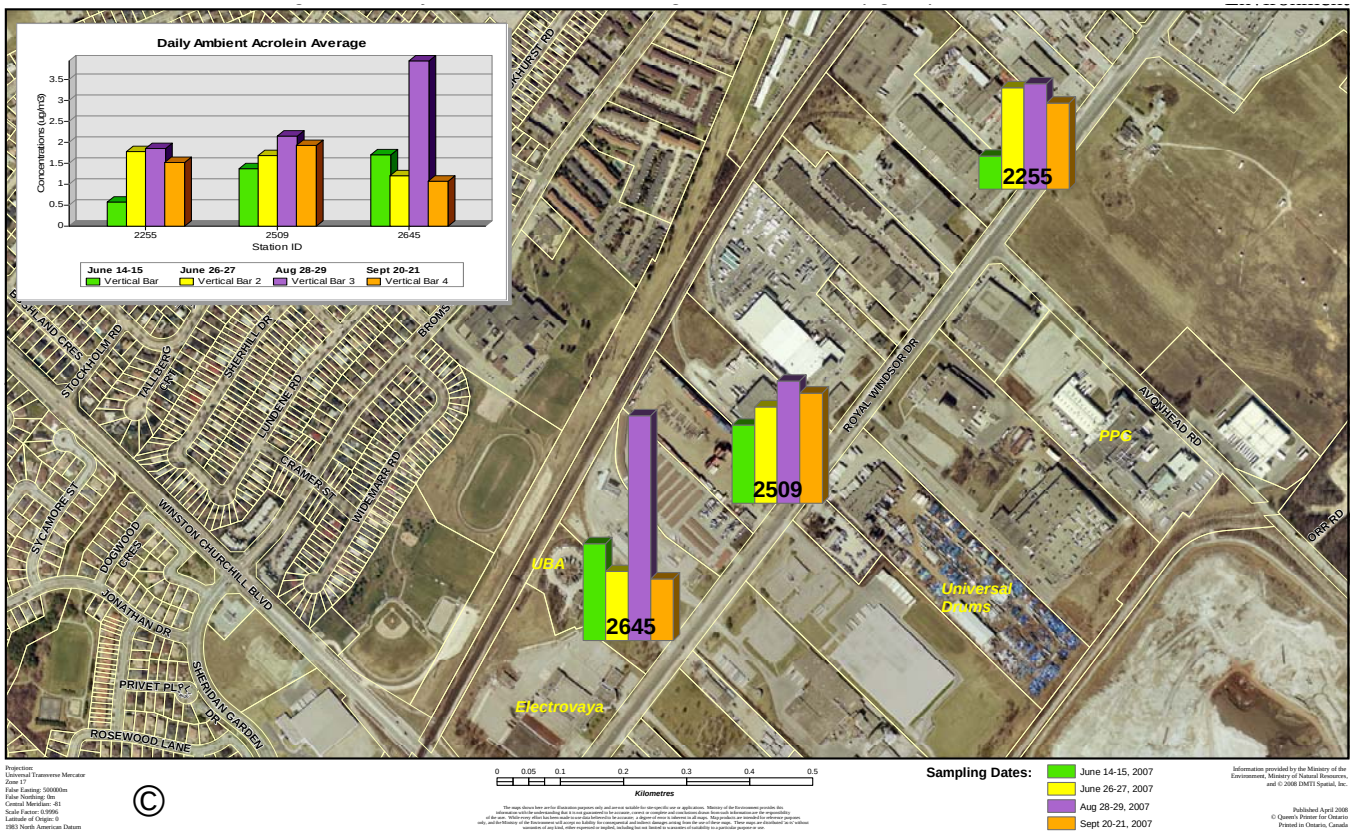
also exceed the O. Reg. 419/05 Upper Risk Threshold (Schedule 6) of 0.8 µg/m^3. However, it is important to note that these standards are based on point of impingement (POI), single source releases, and not the cumulative impacts from all the industries and other potential sources in the area.

Figure 6 shows the spatial variation between the three monitoring stations. Referring to the windrose patterns associated with the sampling events, it is not possible to infer any consistent correlation between wind direction and acrolein concentrations measured. Individual point sources may contribute significantly to maximum 24-hour acrolein concentrations measured, but it is more likely that all industrial point sources and area sources (vehicle emissions) cumulatively contribute to these maximum values.

As shown in Table 1, acrylonitrile levels at all stations were recorded below the detection limit and did not exceed the O. Reg. 419/05 Schedule 3 24-hour standard of 0.6 µg/m^3. During Phase II of the Clarkson Airshed study, the maximum 24-hour acrylonitrile average result obtained was 18.31 µg/m^3 at the Ford Drive station.

Dichloromethane levels are also presented in Table 1. This compound exceeded the AAQC 24-hour standard of 220 µg/m^3 during the Phase II of the Clarkson Airshed Study by 12%. Based on the four sampling events, all the daily dichloromethane levels were below the O. Reg. 419/05 24-hour Schedule 3 standard of 220 µg/m^3. The maximum 24-hour average concentration of 126 µg/m^3 was obtained on September 20-21, 2007 at the 2509 Royal Windsor Drive station.

Figure 6 Daily (24 h) Average Ambient Acrolein Concentrations (µg/m^3) in south Mississauga, Summer 2007



Conclusions

Based on 2007 measurements, and its potential to exceed O. Reg. 419/05 Schedule 3 air standards, which come into effect in 2010, acrolein remains an air quality parameter of concern in the south Mississauga area. Acrylonitrile and dichloromethane concentrations appear to be reduced from Phase II levels

The results from the three sampling locations and the twelve samples, coupled with Phase II results, are statistically insufficient to determine the source(s) contributing to the acrolein exceedances. Based upon poor correlation with wind direction, no one particular point source can be attributed to exclusively contributing to the elevated acrolein concentrations measured. Rather, all industrial point sources and vehicle emissions in the area emitting acrolein likely contribute to the levels measured.

Accordingly, the Ministry of the Environment has decided to undertake additional measurements in the same vicinity of sampling undertaken in 2007 to better characterize VOC concentrations and to identify likely sources. To isolate individual sources of the VOCs of concern, particularly acrolein sources, it will be necessary for future monitoring to undertake short-term sampling (½ hour) at the point of impingement under conditions when wind speed and direction remain relatively constant. Although 2007 levels of

acrylonitrile and dichloromethane appear to be reduced from 2004 levels, these compounds should continue to be monitored to discount the possibility of missing possible higher concentrations by random sampling or being an artifact of the sampling locations chosen.

The results of this study have been shared with the Region of Halton and Region of Peel Public Health Units for their information.

Appendix 1: Summary of sampling conditions for Acrolein, Acrylonitrile and Dichloromethane in Ambient Air – south Mississauga, Summer 2007.

June 14 2007 - Acrolein/Acrylonitrile

					GPS Locations		Electrovaya Meteorological			Sampling Time			
Sample #	**Sample Location**	**Canister ID**	**Initial Vacuum (inch Hg)**	**Final Vacuum (inch Hg)**	**X**	**Y**	**MET (WS) m/s**	**MET (WD) deg**	**Ambient Temp.**	**Started (EST)**	**Finished (EST)**	**Elapsed Time (h:min)**	**NOTES**
1	2255 Royal Windsor	EPS 216	-30	-4.5	610288	4817896	2.1	256.5	24.1	14/06/2007 10:15	15/06/2007 10:15	24.00	
2	2509 Royal Windsor	MOE 024	-29	-5.5	609897	4817397	2.1	256.5	24.1	14/06/2007 10:20	15/06/2007 10:20	24.00	
3	2645 Royal Windsor	MOE 009	-28.5	-4	609661	4817076	2.1	256.5	24.1	14/06/2007 10:24	15/06/2007 10:25	24.01	
	Notes	No Met Data, only 2 hours during the 24-hour period is available (met data listed above is from 9:00 am)											

June 26-27 2007 - Acrolein/Acrylonitrile

					GPS Locations		Wind Parameter			Sampling Time			
Sample #	**Sample Location**	**Canister ID**	**Initial Vacuum (inch Hg)**	**Final Vacuum (inch Hg)**	**X**	**Y**	**MET (WS) Km/h**	**MET (WD) deg**	**Field Notes**	**Started (EST)**	**Finished (EST)**	**Elapsed Time (h:min)**	**NOTES**
1	2255 Royal Windsor	MOE 022	-28	-5.5	610288	4817896	None	None	None	2007/06/26 10.35	27/06/2007 10:35	24.00	
2	2509 Royal Windsor	MOE 001	-30	-7.2	609897	4817397	None	None	None	2007/06/26 10.40	27/06/2007 10:40	24.00	
3	2645 Royal Windsor	MOE 019	-30	-5.5	609661	4817076	None	None	None	2007/06/26 10.45	27/06/2007 10:45	24.00	
	Notes	No Met Data											

August 28-29 /2007 -
Acrolein/Acrylonitrile

					GPS Locations		Wind Parameter			Sampling Time			
Sample #	**Sample Location**	**Canister ID**	**Initial Vacuum (inch Hg)**	**Final Vacuum (inch Hg)**	**X**	**Y**	**MET (WS) Km/h**	**MET (WD) deg**	**Field Notes**	**Started (EST)**	**Finished (EST)**	**Elapsed Time (h:min)**	**NOTES**
1	2255 Royal Windsor	MOE009	-29	-5	610288	4817896				28/08/2007 16:27	29/08/2007 16:04	23.37	
2	2509 Royal Windsor	MOE016	-29	-7	609897	4817397				28/08/2007 16:44	29/08/2007 16:16	23.32	
3	2645 Royal Windsor	MOE006	-30	-5	609661	4817076				28/08/2007 16:50	29/08/2007 16:25	23.35	
	Notes	No Met Data											

September 20-21/20074-
Acrolein/Acrylonitrile

					GPS Locations		Wind Parameter			Sampling Time			
Sample #	**Sample Location**	**Canister ID**	**Initial Vacuum (inch Hg)**	**Final Vacuum (inch Hg)**	**X**	**Y**	**MET (WS) Km/h**	**MET (WD) deg**	**Field Notes**	**Started (EST)**	**Finished (EST)**	**Elapsed Time (h:min)**	**NOTES**
1	2255 Royal Windsor	MOE013	-29	-3	610288	4817896				20/09/2007 11:16	21/09/2007 11:06	23.50	
2	2509 Royal Windsor	MOE001	-29	-6	609897	4817397				20/09/2007 10:52	21/09/2007 10:45	23.53	
3	2645 Royal Windsor	MOE015	-30	-4	609661	4817076				20/09/2007 11:04	21/09/2007 10:55	23.51	
	Notes	No Met Data											